Racial Disparities in Health-Related Quality of Life After Lung Cancer Surgery

Findings From the Cancer Care Outcomes Research and Surveillance Consortium

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Introduction: This study investigated racial disparities in postsurgical health-related quality of life (HRQOL) among patients with non–small-cell lung cancer (NSCLC).

Methods: Data were collected by the Cancer Care Outcomes Research and Surveillance Consortium. Inclusion criteria were greater than or equal to 21 years of age, NSCLC, and receipt of surgery. HRQOL data were available from patients' surveys, and complete medical record abstraction was performed to obtain clinical data. HRQOL was assessed by the physical/mental component summary scores (PCS/MCS) of the 12-item Short-Form Health Survey at two time points. Mean time between surgery and the initial assessment (time 1) after surgery was 4.1 (SD 2.2) months and between surgery and second assessment (time 2) was 12.7 (SD 3.8) months. Multivariable linear regression models were used to examine associations between race and HRQOL.

Results: Of 650 patients, 80.5% were White, 8.8% Black, and 10.7% other races. At second assessment, Blacks reported lower MCS than Whites (47.4 versus 52.6, $p = 0.002$). In multivariable analysis, Blacks had lower MCS compared with Whites. No difference was found between Whites and Blacks on PCS. Those with less than high school education reported lower MCSs. Older age and receipt of adjuvant chemotherapy after surgery were associated with gain in MCS. Male, less than college education, and comorbidities were associated with impaired PCS. Older age was associated with improved PCS.

Conclusion: Racial disparities exist in postoperative mental HRQOL. Results highlight the need for interventions after lung cancer surgery to improve mental health in Black and younger patients.

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Lung cancer is the leading cause of cancer-related death in the United States. It is estimated that there will be 224,210 new lung cancer cases and 159,260 deaths from lung cancer in 2014.[1] Blacks suffer a greater burden of disease from lung cancer compared with other racial/ethnic groups and tend to have higher prevalence and mortality from lung cancer.[2,3] Despite advances in treatment, compared with Whites, Blacks with lung cancer have lower 5-year survival rates (16% versus 13%),[4] are less likely to undergo invasive staging,[5] and receive surgical resection less frequently (63.4% versus 44.7%).[6]

Surgical resection remains the best available treatment to enhance long-term survival for patients with early-stage (stages I and II) non–small-cell lung cancer (NSCLC). The 5-year postoperative survival rate for patients with stage I NSCLC ranges from 55% to 72%. If not treated surgically, the 5-year survival rate ranges from 4% to 14%.[7] However, lung cancer surgery has the potential to negatively affect health-related quality of life (HRQOL).[8–10] Studies have reported that HRQOL was lower during the first 3 to 6 months after surgery and then improved over time.[9,11,12] A recent study found that at 6 months after lung cancer surgery 59% of patients reported lower physical HRQOL and 33% reported lower mental HRQOL compared with preoperative HRQOL.[8]

HRQOL in patients with lung cancer from different racial groups is of particular interest because when compared with their White counterparts, Black patients have poorer HRQOL,[13] and it has been found that poor HRQOL is strongly associated with increased risk of death among lung cancer patients.[14] In fact, 10% decrease in physical and mental HRQOL during the first 6 months after lung cancer surgery was associated with 18% and 13% increased risk of death, respectively.[14] The relationship between an individual's racial background and postoperative HRQOL is complex and may be mediated by patients' demographic, socioeconomic (e.g., income, education), and clinical (e.g., disease stage, comorbidities) characteristics. Previous studies demonstrated that

Blacks are more likely than Whites to report lower household income,[6,15] education attainment,[6,16] being uninsured or covered by Medicaid,[6,17,18] being unmarried,[6,19] being diagnosed at advanced-stage lung cancer (stage III or IV),[18,20] at a younger age,[20] have greater prevalence of comorbidities,[21,22] and less likely to successfully quit smoking,[23] and all these factors are associated with HRQOL of lung cancer patients.[10,24–27] Although several studies examining HRQOL after lung resection have been conducted over the past decade,[10] the relationship between race and HRQOL is poorly understood. Literature suggests that several factors (e.g., higher rates of poverty, lack of health insurance, more advanced stage at diagnosis) may account for a substantial part of the observed racial/ethnic differences in lung cancer outcomes.[28,29] To our knowledge, no studies have analyzed the effect of race on HRQOL while controlling for these important factors. Thus, we performed a prospective population-based study to investigate racial disparities in postsurgical HRQOL among a cohort of patients with newly diagnosed NSCLC and identified characteristics associated with HRQOL after lung cancer surgery. Because prior research indicates substantial racial/ethnic differences in lung cancer outcomes,[2,28,30,31] it is possible that differences regarding HRQOL after surgical procedure may also exist. We hypothesized that Blacks would report less improvement in physical and mental HRQOL than Whites after controlling for demographic, socioeconomic, and clinical factors. To enhance HRQOL after lung cancer surgery, it is important to identify subgroups of lung cancer patients with an increased risk of poor HRQOL, then to develop appropriate interventions that can be delivered after lung cancer surgery. Enhancing HRQOL after lung cancer surgery might ultimately improve survival.

MATERIALS AND METHODS

Data Source

Data for this study were collected by the Cancer Care Outcomes Research and Surveillance (CanCORS) Consortium. The consortium examined variations in care and outcomes of care for patients with newly diagnosed lung and colorectal cancers between 2003 and 2005 with follow-up data for as long as 15 months after diagnosis.[32] Data were collected from patient surveys, medical records abstraction, physician surveys, and surveys of informal caregivers using computer-assisted telephone interviews in English, Spanish, and Mandarin and Cantonese Chinese.[33] Details on study design and procedures have been previously published.[32,34] Patients were living in Northern California, Los Angeles County, North Carolina, Alabama, Iowa, or received care in one of the five large integrated health care systems or in one of the 15 Veterans Health Administration hospitals. In 2004, the study catchment areas included nearly 30 million people, representing 10% of the United States population.[32,33] Human subjects committees at all participating institutions approved the study. In this analysis, we used data from two different sources: (1) patient surveys obtained approximately 4 months after diagnosis (time 1) and again approximately 11 to 13 months after diagnosis (time 2) and (2) medical records from physicians involved in the patients' cancer care from 3 months before to 15 months after diagnosis.[32] The majority of newly diagnosed lung cancer patients had surgery before the first patient survey (time 1).

Study Population

Forty-nine percent of eligible patients with lung cancer participated in the CanCORS study.[34] Comparisons of responders and nonresponders have been described previously.[35] In the CanCORS sites affiliated with Surveillance, Epidemiology, and End Results registries, the CanCORS cohort was similar to Surveillance, Epidemiology, and End Results in ethnic distribution (Black, 11.8% versus 9.8%; Hispanic, 4.8% versus 5.3%; Asian, 3.6% versus 4.7%).[34]

In the CanCORS cohort, there were a total of 1228 patients aged greater than or equal to 21 years with diagnoses of NSCLC who received primary surgery and had accompanying medical records data available (Fig. 1). Then, 109 patients were dropped because they lacked at least 3 months between the baseline and follow-up surveys. The HRQOL data were available from baseline and follow-up surveys from 844 patients. Another 194 observations were dropped because of lost from nonimputed items in the 844 patients with at least some data from both the baseline and follow-up survey. The CanCORS team applied sequential iterative imputation algorithms to fill in many missing items but excluding certain patient attributes that could not be accurately imputed, e.g., race. Multiple imputed models were only constructed for

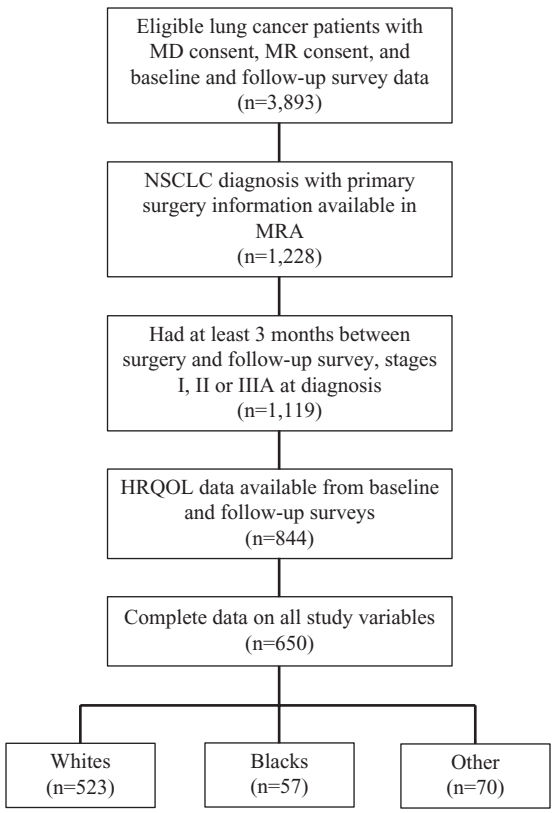

FIGURE 1. Study cohort, cancer care outcomes research and surveillance cohort selection. HRQOL, health-related quality of life; MD, medical doctor; MR, medical record; MRA, medical record abstraction; NSCLC, Non–small-cell lung cancer.

CanCORS patient surveys. There were multiple versions of each patient survey (e.g., a "brief" version for patients too sick to complete an entire survey), and data missing because of survey type were not imputed. For example, patients who completed the brief survey were not asked about their smoking status or insurance information, so we did not imputed values for those patients.[36,37] This resulted in 650 patients with complete data on all covariates.

A nonresponse analysis (available on request) of the 194 patients with incomplete data indicated that they were more likely to be younger, black, married or living with a partner, and more educated with higher incomes. Over 50% of subjects with incomplete, nonimputable data reportedly had stage IIIB/IV cancer, which resulted in no patients in these stages in the final analytic sample. Multivariate regression is used to control for any systematic effects that sample deletions may have had on HRQOL.

HRQOL Assessment

The Medical Outcomes Study 12-item Short-Form Health Survey (SF-12) was used to measure HRQOL.[38] This measure has two subscales: physical component summary (PCS; six items) and mental component summary (MCS; six items). The PCS is based on physical functioning, role limitations as a result of physical health problems, bodily pain, and general health perception domains. The MCS is based on general mental health, role limitations as a result of emotional problems, social functioning, and vitality domains. The two summary measures use norm-based scoring algorithms that are standardized by the sample mean (50) and standard deviation (10) of the general population. Higher scores on SF-12 indicate better quality of life, and higher summary scores reflected better mental and physical health.[38] HRQOL was assessed at two time points after lung cancer surgery. Mean time between surgery and time 1 assessment after surgery was 4.1 (SD 2.2) months, and between surgery and time 2 assessment was 12.7 (SD 3.8) months.

Covariates

Race, age, sex, and marital status were obtained from the time 1 patient survey. For patients with no response to the interview item, data were obtained from medical record abstraction or if both data sources were missing, from tracking records. Annual household income, education, insurance, smoking status, and social support also came from the time 1 assessment. Emotional/informational and tangible support was measured using the Medical Outcomes Study Social Support Survey, administered during the time 1 survey.[39]

Clinical characteristics, including disease stage at the time of diagnosis, receipt of adjuvant chemotherapy, comorbidity, and types of lung cancer surgery, were abstracted from medical records. Collaborative stage (American Joint Committee on Cancer)[40] at the time of diagnosis was categorized as stage I, stage II, or stage IIIA. Receipt of adjuvant chemotherapy was indicated within 6 months of lung cancer surgery. Comorbidity at the time of diagnosis was measured using the Adult Comorbidity Evaluation 27 instrument, a 27-item index that was developed and validated for patients with cancer.[41] Surgery type was categorized as limited resection, lobectomy/bilobectomy, or pneumonectomy. To control for varying recovery times between surgery and follow-up assessment, we created a time-since-surgery variable based on the difference between the time of surgery and the second assessment.

Statistical Analysis

Baseline characteristics between Blacks and Whites were compared using a χ^2 test. Two-sample *t* tests were used to compare social support and HRQOL differences between Whites and Blacks. We used multivariable linear regressions to model the effect of race on PCS and MCS by sequentially controlling for patient sociodemographic and clinical factors. The dependent variables for the analysis, PCSs and MCSs, were based on the second assessment. Three separate linear regression models were estimated for PCS and MCS. The first model included patients' HRQOL scores from time 1 assessment, race, age, sex, and time since surgery. Including baseline HRQOL scores requires regression coefficients to be interpreted as the difference in follow-up HRQOL scores between baseline and follow-up within each reference group (e.g., white females). In the second model, we added mediating variables including marital status, income, education, smoking status, and social support. These variables are thought to influence HRQOL and patients' lung cancer condition and being influenced by the basic demographic characteristics. In the final model, we added insurance, comorbidity, disease stage, type of surgery, and adjuvant chemotherapy. Now, coefficients in models 1 and 2 are interpreted after controlling for cancer condition such as comorbidities. We used patient survey V1.11, MRA V1.12, and core V1.14. A two-sided *p* value less than or equal to 0.05 was used to indicate statistical significance. Analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

Sample Characteristics

Of the 650 patients, 80.5% were White, 8.8% were Black, and 10.7% were of other race. Blacks, Whites, and other patients did not differ significantly in most demographic and clinical characteristics with the exception of education and income. Compared with Whites and others, Blacks were less educated ($p = 0.03$) and had lower income ($p = 0.05$). More Blacks (24.5%) had less than a high-school level education compared with Whites (15.5%) and others (18.6%). Overall 19% of the respondents reported having a bachelor's degree or higher, but this was most often the case for Whites (21.0%), followed by others (14.3%), then Blacks (7%). Similarly, a larger proportion of Blacks were in the lowest yearly household income bracket (less than $20,000; 38.6%) compared with Whites (24%) and others (20.0%; Table 1).

Black and White Difference in HRQOL

The PCSs and MCSs were comparable between Blacks and Whites at time 1 (Table 2), and no significant difference was found in PCSs between these two groups at time 2. The

TABLE 1. Patient Characteristics by Race (n = 650)

Characteristics	All Participants Frequencies (%)	White (n = 523) Frequencies (%)	Black (n = 57) Frequencies (%)	Other (n = 70) Frequencies (%)	χ^2	ρ
Age at diagnosis					10.2	0.11
21–52	48 (7.4)	34 (6.5)	7 (12.3)	7 (10.0)		
53–64	199 (30.6)	151 (28.9)	22 (38.6)	26 (37.2)		
65–79	338 (52.0)	287 (54.9)	22 (38.6)	29 (41.4)		
≥80	65 (10.0)	51 (9.7)	6 (10.5)	8 (11.4)		
Gender					1.9	0.37
Male	358 (55.0)	284 (54.3)	30 (52.6)	44 (62.9)		
Female	292 (45.0)	239 (45.7)	27 (47.4)	26 (37.1)		
Marital status					4.1	0.12
Married/living with partner	396 (61.0)	322 (61.6)	28 (49.1)	46 (65.7)		
Not married	254 (39.0)	201 (38.4)	29 (50.9)	24 (34.3)		
Education					2.56	0.03
Not HS graduate	108 (16.6)	81 (15.5)	14 (24.5)	13 (18.6)		
HS/less BS degree	409 (63.0)	328 (62.7)	37 (65.0)	44 (62.8)		
BS degree or higher	124 (19.0)	110 (21.0)	4 (7.0)	10 (14.3)		
Missing	9 (1.4)	4 (0.8)	2 (3.5)	3 (4.3)		
Income ($)					2.16	0.05
<20,000	161 (24.8)	125 (24.0)	22 (38.6)	14 (20.0)		
20,000 to <40,000	151 (23.2)	133 (25.4)	6 (10.5)	12 (17.1)		
40,000 to <60,000	107 (16.5)	90 (17.2)	6 (10.5)	11 (15.7)		
≥60,000	103 (15.8)	88 (16.8)	6 (10.5)	9 (12.9)		
Missing	128 (19.7)	87 (16.6)	17 (29.8)	24 (34.3)		
Insurance					0.83	0.50
Private/VA/military	211 (32.5)	167 (31.9)	21 (36.8)	23 (32.8)		
Medicare	402 (61.8)	332 (63.5)	29 (50.9)	41 (58.6)		
Low income/other	13 (2.0)	8 (1.5)	2 (3.5)	3 (4.3)		
Missing	24 (3.7)	16 (3.1)	5 (8.8)	3 (4.3)		
Smoking status					0.83	0.43
Current smokers	63 (9.7)	50 (9.6)	5 (8.8)	8 (11.4)		
Nonsmokers	499 (76.8)	415 (79.3)	38 (66.7)	46 (65.7)		
Missing	88 (13.5)	58 (11.1)	14 (24.5)	16 (22.9)		
Stage					8.0	0.08
I	467 (71.8)	381 (72.8)	35 (61.4)	51 (72.9)		
II	120 (18.4)	94 (18.0)	11 (19.3)	15 (21.4)		
IIIA	63 (9.7)	48 (9.2)	11 (19.3)	4 (5.7)		
Type of surgery					4.1	0.39
Limited resection	143 (22.0)	113 (21.6)	13 (22.8)	17 (24.3)		
Lobectomy/Bilobectomy	410 (63.0)	338 (64.6)	34 (59.7)	38 (54.3)		
Pneumonectomy	97 (15.0)	72 (13.8)	10 (17.5)	15 (21.4)		
Adjuvant chemotherapy					2.3	0.31
Yes	182 (28.0)	148 (28.3)	19 (33.3)	15 (21.4)		
No	468 (72.0)	375 (71.7)	38 (66.7)	55 (78.6)		
Comorbidity					5.4	0.48
None	89 (13.7)	75 (14.3)	5 (8.8)	9 (12.9)		
Mild	262 (40.3)	206 (39.4)	28 (49.1)	28 (40.0)		
Moderate	174 (26.8)	137 (26.2)	18 (31.6)	19 (27.1)		
Severe	125 (19.2)	105 (20.1)	6 (10.5)	14 (20.0)		
Social support		n = 468, Mean (SD)	n = 44, Mean (SD)	n = 54, Mean (SD)		
Emotional or informational		84.2 (21.8)	81.9 (21.8)	82.3 (23.2)		
Tangible[a]		83.8 (24.1)	77.5 (25.6)	83.1 (25.7)		

[a]n = 465.
BS, Bachelor's degree; HS, High School; SD, standard deviation; VA, Veteran's administration.

TABLE 2. Mean PCSs and MCSs between Whites and Blacks

	White	Black	
	Mean (SD)		*P* Value
$PCS_{time\ 1}$	38.1 (11.3)	38.0 (10.7)	0.97
$MCS_{time\ 1}$	51.3 (11.5)	48.9 (10.2)	0.13
$PCS_{time\ 2}$	39.5 (11.4)	38.9 (10.5)	0.74
$MCS_{time\ 2}$	52.6 (11.7)	47.4 (13.0)	0.002

Time 1: 4.1 (SD 2.2) months after surgery on average.
Time 2: 12.7 (SD 3.8) months after surgery on average.
MCS, mental component score, PCS, physical component score; SD, standard deviation.

MCS, however, was significantly lower among Blacks than Whites (47.4 versus 52.6, $p = 0.002$) at time 2. No significant difference was found in PCSs between these two groups at time 2 (Table 2). The MCS, however, was a clinically significant 11% lower among Blacks than Whites (47.4 versus 52.6, $p = 0.002$) at time 2.

Multivariable Analysis

The multiple linear regression results for PCSs and MCSs are presented in Tables 3 and 4, respectively. Covariates in the fully specified model (model 3) explained 42% of the variance in PCSs at time 2 (adjusted R^2). There was no significant association between PCSs at time 2 and race in all three models. In the full model (model 3), factors that were significantly associated with less gain in PCS included being male, lower education level, and comorbidities. Older patients showed substantial gains in PCSs after comorbidities were held constant in the model, implying that their compromised health status plays a major role in limiting their gains from surgery (as indicated by model 1). Marital status, income, insurance, social support, smoking status, and clinical characteristics, including disease stage, type of surgery, time since surgery, and receipt of adjuvant chemotherapy, were not associated with PCSs at time 2 (Table 3).

Covariates in the fully specified model accounted for 39% of the variance in MCSs at time 2. Blacks had significantly lower MCSs at time 2 than Whites in all three models. Older patients and those who received adjuvant chemotherapy within 6 months of surgery exhibited significantly higher MCSs at time 2, whereas less educated patients reported lower MCS at time 2, holding all other factors constant. Male gender was associated with higher MCSs at time 2 (Model 1), but, after controlling for all factors, there was no statistically significant difference based on gender. Marital status, income, insurance, social support, smoking status, and clinical characteristics, such as disease stage, type of surgery, time since surgery, and comorbidity, were not associated with MCSs at time 2 (Table 4).

DISCUSSION

In this population-based prospective cohort study of patients who underwent surgery for lung cancer, we found that compared with Whites, Blacks had lower mental health scores at follow-up even after controlling for demographic and clinical factors. Thus, our study provided evidence suggesting that there were racial disparities in the mental aspect of HRQOL after lung cancer surgery but not in the physical aspect of HRQOL. After lung cancer surgery, Black patients report lower self-reported mental health than Whites. One explanation may be that Blacks are more likely to have less access to psychosocial services than Whites,[2] possibly because of lower incomes and educational attainment.[42] Other factors may also impact mental health for blacks after surgery for NSCLC including cultural norms and stigma.[43]

To our knowledge, this is the first study that investigated the effect of race on the postsurgical HRQOL among patients with NSCLC. No previous studies are available to compare the study findings with our study. However, a recent study, by Traeger et al.,[31] investigated race by sex differences in depression symptoms among non-Hispanic Blacks and Whites with lung cancer using the Center for Epidemiologic Studies Depression Scale. Investigators reported that Black men (24.7%) had the highest prevalence of depression symptoms followed by White women (20.6%), Black women (15.8%), and White men (15.0%).[31] Comparisons were not exact because Traeger et al.[31] included all lung cancer patients regardless of treatment in their study sample, whereas, in our sample, we included only participants who had surgical treatment for NSCLC. Taken together, findings of these studies provide evidence of significant differences in mental health between Whites and Blacks with lung cancer. The findings of this study highlight the need to assess psychosocial concerns before surgery and referral for psychosocial care as recommended by the American College of Surgeon's Commission on Cancer credentialing standards,[44,45] to improve mental health after surgery for lung cancer. The beneficial effects of providing psychosocial care to cancer patients are well recognized.[46] This screening may identify patients who would benefit from further assessment, psychosocial support programs, and treatment of significant mental health concerns. Given the findings of this study, this may be especially important for Black patients receiving surgery for the treatment of NSCLC.

Additional findings in our study warrant special note. Our results are consistent with literature indicating that respondent education level, age, and gender are associated with HRQOL after lung cancer surgery.[8,10,47] In this study, patients who did not graduate from high school had lower scores in physical and mental HRQOL than participants who had a bachelor's degree or higher, confirming previous research that reported education as a risk factor for poor outcomes for lung cancer.[48] Older age was associated with higher scores for both mental and physical health. One possible explanation is that older patients may process the experience of cancer and the benefits of surgery differently than younger patients. In addition, older patients may have well-developed life skills and more experience navigating life challenges that make them better prepared to face the challenges of a cancer diagnosis and treatment. Findings from other research studies investigating age differences are mixed. Some studies reported older patients had better mental HRQOL compared with younger patients after lung cancer surgery.[26,47] Other studies found older patients had

TABLE 3. Linear Regression Analysis Explaining PCS (n = 650)

	$PCS_{time\ 2}$		
	Model 1	**Model 2**	**Model 3**
Variables	**β, 95% CI, *p***	**β, 95% CI, *p***	**β, 95% CI, *p***
Intercept	18.65, 14.44 to 22.86, <0.0001	22.76, 15.96 to 29.57, <0.0001	25.28, 16.18 to 34.38, <0.0001
$PCS_{time\ 1}$	0.58, 0.51 to 0.64, <0.0001	0.56, 0.49 to 0.62, <0.0001	0.55, 0.48 to 0.61, <0.0001
Race			
White	1.00	1.00	1.00
Black	−0.25, −2.76 to 2.26, 0.84	0.94, −1.59 to 3.47, 0.46	0.82, −1.70 to 3.34, 0.52
Other	−0.16, −2.49 to 2.16, 0.89	0.07, −2.23 to 2.36, 0.95	0.16, −2.15 to 2.46, 0.89
Age			
21–52	1.00	1.00	1.00
53–64	−0.19, −3.07 to 2.68, 0.89	0.01, −2.80 to 2.81, 0.99	1.09, −1.82 to 4.00, 0.46
65–79	1.14, −1.70 to 3.99, 0.43	1.31, −1.46 to 4.08, 0.35	3.88, 0.50 to 7.25, 0.02
≥80	2.17, −1.35 to 5.69, 0.22	1.79, −1.66 to 5.23, 0.30	4.38, 0.27 to 8.48, 0.03
Sex			
Female	1.00	1.00	1.00
Male	−2.20, −3.63 to −0.77, 0.002	−2.39, −3.84 to −0.92, 0.001	−2.24, −3.70 to −0.76, 0.002
Time since surgery	−0.65, −0.24 to 0.12, 0.51	−0.06, −0.24 to 0.11, 0.46	−0.08, −0.26 to 0.09, 0.35
Marital status			
Married/living with partner		1.00	1.00
Not married		−1.08, −2.75 to 0.60, 0.20	−1.02, −2.68 to 0.64, 0.23
Income ($)			
≥60,000		1.00	1.00
<20,000		−2.82, −5.91 to 0.26, 0.07	−2.39, −5.48 to 0.70, 0.12
20,000 to <40,000		0.003, −2.31 to 2.31, 0.99	0.25, −2.11 to 2.60, 0.83
40,000 to <60,000		0.02, −2.60 to 2.63, 0.99	0.20, −2.36 to 2.75, 0.87
Education			
BS or higher		1.00	1.00
Not HSG		−2.95, −5.53 to −0.36, 0.02	−2.69, −5.31 to −0.07, 0.04
HSG/less BS		−2.24, −4.18 to −0.31, 0.02	−2.08, −4.01 to −0.14, 0.03
Social support			
EIS		−0.02, −0.07 to 0.03, 0.38	−0.01, −0.05 to 0.03, 0.35
Tangible		−0.005, −0.05 to 0.03, 0.82	−0.02, −0.07 to 0.02, 0.73
Smoking status			
Current smokers		1.00	1.00
Nonsmokers		2.17, −1.33 to 5.66, 0.20	2.03, −1.47 to 5.53, 0.23
Insurance			
Low income/other			1.00
Medicare			−2.17, −8.68 to 4.33, 0.83
Private/VA/Mlt			−0.63, −6.85 to 5.59, 0.50
Comorbidity			
None			1.00
Mild			−2.28, −4.52 to −0.05, 0.04
Moderate			−3.08, −5.43 to −0.72, 0.01
Severe			−4.44, −6.97 to −1.91, 0.0006
Stage			
I			1.00
II			−0.86, −2.82 to 1.09, 0.38
IIIA			0.11, −2.36 to 2.58, 0.93
Type of surgery			
Limited resection			1.00
LB/BB			−0.04, −1.82 to 1.74, 0.96
PN			1.70, −0.66 to 4.05, 0.15
Adjuvant chemotherapy			
No			1.00
Yes			0.71, −0.93 to 2.35, 0.39

BB, bilobectomy; BS, bachelor degree; CI, confidence interval; EIS, emotional or informational support, HSG, high school graduate; LB, lobectomy; Mlt, military; PCS, physical component summary; PN, pneumonectomy; VA, Veteran's administration.

TABLE 4. Linear Regression Analysis Explaining MCS (n = 650)

	$MCS_{follow-up}$		
	Model 1	**Model 2**	**Model 3**
Variables	**β, 95% CI, *p***	**β, 95% CI, *p***	**β, 95% CI, *p***
Intercept	19.08, 14.25 to 23.09, <0.0001	18.21, 11.98 to 24.44, <0.0001	17.79, 9.16 to 26.41, <0.0001
$MCS_{baseline}$	0.54, 0.47 to 0.60, <0.0001	0.51, 0.44 to 0.58, <0.001	0.51, 0.43 to 0.58, <0.0001
Race			
White	1.00	1.00	1.00
Black	−3.17, −5.83 to −0.51, 0.01	−2.93, −5.62 to −0.24, 0.03	−2.73, −5.41 to −0.05, 0.04
Other	−0.15, −2.59 to 2.29, 0.90	0.06, −2.37 to 2.49, 0.96	0.49, −1.95 to 2.92, 0.69
Age			
21–52	1.00	1.00	1.00
53–64	2.80, −0.20 to 5.80, 0.06	2.91, −0.13 to 5.96, 0.06	3.32, 0.19 to 6.44, 0.03
65–79	5.24, 2.30 to 8.17, 0.0005	5.45, 2.43 to 8.46, 0.0004	7.85, 4.22 to 11.48, <0.0001
≥80	5.50, 1.91 to 9.90, 0.002	5.78, 2.12 to 9.43, 0.002	9.03, 4.77 to 13.28, <0.0001
Sex			
Female	1.00	1.00	1.00
Male	1.51, −0.00 to 3.03, 0.05	1.45, −0.10 to 3.01, 0.06	1.39, −0.17 to 2.95, 0.08
Time since surgery	0.04, −0.14 to 0.23, 0.64	0.06, −0.13 to 0.25, 0.54	0.05, −0.14 to 0.25, 0.57
Marital status			
Married		1.00	1.00
Not married		−0.31, −2.10 to 1.48, 0.73	−0.28, −2.07 to 1.51, 0.75
Income ($)			
≥60,000		1.00	1.00
<20,000		1.06, −1.58 to 3.71, 0.43	1.11, −1.58 to 3.81, 0.41
20,000 to <40,000		−0.49, −2.94 to 1.95, 0.69	−0.53, −2.99 to 1.92, 0.66
40,000 to <60,000		−0.26, −2.72 to 2.21, 0.83	−0.50, −2.99 to 1.98, 0.69
Education			
BS or higher		1.00	1.00
Not HSG		−3.69, −6.42 to −0.95, 0.008	−3.87, −6.59 to −1.15, 0.005
HSG/less BS		−0.75, −2.79 to 1.28, 0.46	−0.84, −2.87 to 1.19, 0.41
Social support			
EIS		0.04, −0.01 to 0.10, 0.09	0.04, −0.01 to 0.09, 0.11
Tangible		−0.005, −0.05 to 0.04, 0.80	−0.01, −0.05 to 0.04, 0.75
Smoking status			
Current smokers		1.00	1.00
Nonsmokers		0.10, −2.81 to 3.02, 0.94	0.05, −2.72 to 2.82, 0.97
Insurance			
Low income			1.00
Medicare			−2.40, −9.16 to 4.35, 0.98
Private/VA/Mlt			0.07, −6.47 to 6.63, 0.47
Comorbidity			
None			1.00
Mild			−0.40, −2.76 to 1.96, 0.73
Moderate			−0.98, −3.54 to 1.56, 0.44
Severe			1.18, −1.59 to 3.95, 0.40
Stage			
Stage I			1.00
Stage II			0.61, −1.47 to 2.69, 0.56
Stage IIIA			−0.35, −3.01 to 2.28, 0.78
Type of surgery			
Limited resection			1.00
LB/BB			0.03, −1.83 to 1.90, 0.96
PN			−0.53, −3.04 to 1.96, 0.67
Adjuvant chemotherapy			
No			1.00
Yes			3.29, 1.56 to 5.02, 0.0002

BB, bilobectomy; BS, bachelor degree; CI, confidence interval; EIS, emotional or informational support, HSG, high school graduate; LB, lobectomy; Mlt, military; MCS, mental component summary; PN, pneumonectomy; VA, Veteran's administration.

lower physical HRQOL.[8,47] Male patients had lower PCSs than women, which is not consistent with other studies that found no significant difference in physical HRQOL between men and women.[8,47] More investigation is needed to understand age and gender differences in HRQOL after lung cancer surgery. Not surprisingly, participants in this study with comorbidities had significantly lower physical HRQOL after lung cancer surgery that participants without comorbidities, which is consistent with previous reports.[10,25,26,49]

Other studies have reported that patients who received adjuvant chemotherapy after surgery experienced a decline in physical HRQOL but not in mental HRQOL.[10] Similarly, we found that receipt of adjuvant chemotherapy after surgery was associated with a gain in MCS but not with PCS. One possible explanation might be that patients who received adjuvant chemotherapy were more confident about their survival prospects because of active treatment. It is also possible that patients who received adjuvant chemotherapy were more frequently followed during the postoperative period and receive more psychological counseling after surgery, which improves their mental condition. Future studies are needed to understand how adjuvant chemotherapy after surgery affects mental health of patients.

There are several limitations to our study that should be noted. Physical and mental health variables were self-reported and may not reflect true functional health status. HRQOL measures reflect the patients' personal perspectives and may be affected by other factors such as patients' positive/negative experiences with the provider or satisfaction of received care and variables not included in this study. Future studies will be required to investigate the effect of these factors on HRQOL after lung resection.

Although the CanCORS study made an effort to oversample minority patients with lung cancer, we included more Whites than Blacks. Because of small sample sizes, Hispanic and other racial groups besides Blacks were collapsed into an "other" category. We dropped 194 patients because of missing one or more of the covariates needed for the multivariate analysis. Over one-half of dropped patients had advanced stage disease (IIIB/IV) at the time of the diagnosis. Therefore, our results may not be generalizable to patients with advanced-stage lung cancer. Also, deleted patients were more likely to be Black than White (14.4% versus 8.8%). Research shows that minority patients and those with advanced-stage cancer are less likely to enroll in studies.[50] Future studies are needed to include more minority groups.

In summary, this study generated potentially useful information about racial differences in HRQOL for people with NSCLC who received surgery for their disease. Blacks had lower mental health as measured by the SF-12 after surgery than Whites. These finding suggest that Black race influences mental health above and beyond socioeconomic status and clinical factors. There were age-related differences in both physical and mental HRQOL after surgery for lung cancer. In particular, these results provide important information for informed decision making for patients with operable NSCLC. Health care providers should be aware of subgroups of lung cancer patients, such as Blacks, patients with younger age, and lower levels of education who are at higher risk for poorer mental health after lung cancer surgery. The study findings also highlight the need for screening for psychosocial issues before and after lung cancer surgery to identify those who may benefit from targeted interventions to improve mental health and psychosocial outcomes in survivorship. Future studies are needed to explain risk factors for poor mental health among Black patients. Disparities in HRQOL by race persist among lung cancer patients, and understanding the reasons for racial differences in mental health will inform the development of effective, culturally appropriate interventions to enhance HRQOL after lung cancer surgery. Efforts to address HRQOL among Blacks may ultimately improve lung cancer survival.

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